

Appl. No. 10/646,525
Amendment dated June 13, 2006

REMARKS

Claims 23-35, 37-44, 63-68 and 80-95 remain in this application. Claims 43, 44, 63, 67 and 68 have been amended. Claims 23, 43, 63, 67, 68 and 82 are independent claims.

In the Office Action dated May 22, 2006: claims 63-68 were allowed; claims 23-35, 37-39, 41, 43, 44, and 80-82 were rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over U. S. Patent No. 6,312,134 B1 to Jain et al. in view of U.S. Patent Application Publication No. 2002/0080339 A1 to Takahashi; claims 83-88 and 90-95 were rejected under 35 U.S.C. 103(a) as allegedly being unpatentable over U.S. Patent No. 6,312,134 B1 to Jain et al. in view of U.S. Patent Application Publication No. 2002/0080339 A1 to Takahashi and U.S. Patent No. 6,965,364 B1 to Eggers et al.; and claims 40, 42 and 89 were objected to as being dependant upon a rejected base claim.

In response to the rejections, Applicant has amended claims 43, 44, 63, 67 and 68 in order to more clearly distinguish the claimed invention from the cited prior art.

As discussed in Applicant's Amendment/Response dated February 28, 2006, in the claims as originally filed Applicant was using 'spatial light modulator' (SLM) to refer to one or more 'spatial light modulator arrays', where each array is a separate device. Applicant is aware that this usage is confusing and Applicant has adopted a more natural usage for the term 'spatial light modulator' - in the

Appl. No. 10/646,525
Amendment dated June 13, 2006

amended claims 'spatial light modulator' refers to only one device or array (where the array is a separate device). Various claims were amended accordingly in Applicant's last Amendment. Applicant is now making similar amendments to claims 43, 44, 63, 67 and 68 so as to have consistent usage of the term 'spatial light modulator' throughout the entire claim set. Consequently, claims 63 and 67 have been amended to unambiguously claim a lithographic tool with a single spatial light modulator, and claims 43, 44 and 68 have been amended to unambiguously claim a lithographic tool with a plurality of spatial light modulators. Claim 68 has been further amended to require imaging optics configured to project blurred images of each one of the plurality of spatial light modulators, as described throughout Applicant's published application, US 2004/0075882 A1.

In view of the amendments and the remarks that follow, Applicant respectfully asserts that the claims are in a condition for allowance.

A. Patentability of Independent Claim 23

In the determination of patentability of claim 23, the Office Action alleges that it would have been obvious to one having ordinary skill in the art at the time the invention was made to combine the device of Jain et al. with the blurred image of Takahashi et al. Applicant respectfully asserts that claim 23 is patentable over Jain et al. in view of Takahashi et al. Further, Applicant respectfully asserts that it is improper to combine the references in order to reject claim 23 because Jain et al. teach that a blurred image is undesirable. Furthermore, Applicant respectfully asserts that it is improper to combine the

Appl. No. 10/646,525

Amendment dated June 13, 2006

references in order to reject claim 23 because Takahashi et al. teach that a blurred image is undesirable and their invention has a primary purpose of eliminating blurring.

Jain et al. describe the parameters for operation of their lithography tool in order to avoid blurring of the image projected onto the substrate. (Column 7, lines 61-67 and col. 8 lines 1-2.) The sentence in column 8, lines 1-2 refers to a condition that is not desired. Further support for this conclusion is found in col. 7, lines 24-44 where Jain et al. describe criteria required to "ensure that the pattern imaged onto the substrate is not blurred." (Emphasis added.) Furthermore, Jain et al. describe the high resolution projection lens in their seamless scanning technology as forming a precise image on the substrate. (Col. 8, lines 30-34 and 61-66.) In conclusion, Jain et al. teach that a blurred image of the spatial light modulator on the substrate is undesirable.

Takahashi et al. describe a vibration control method and exposure apparatus for use with a stepper or scanning stepper lithography tool. The lithography tool in Takahashi et al. uses a mask or reticle to define the pattern projected onto the substrate (R in Fig. 1); a spatial light modulator is not disclosed. The object of Takahashi's invention is to reduce, and compensate for, vibration in the lithography apparatus that affects the precision of the pattern on the wafer. Vibrations in the lithography tool can lead to blurring of the image on the wafer (paragraph 9), and the invention of Takahashi et al. has a primary purpose of reducing and compensating for such vibrations, thus improving image

Appl. No. 10/646,525
Amendment dated June 13, 2006

resolution and throughput (paragraphs 20-36). One such embodiment is described in paragraph 116, where Takahashi et al. state, starting at the third line of the paragraph, that "transmission of vibration ... to the projection optical system PL and to the reticle R through the reaction frame 8 is *prevented*, resulting in improved exposure accuracy by effectively *preventing* ... image blurring ... due to the vibration." (Emphasis added.) Furthermore, in paragraph 112, Takahashi et al. describe their invention as follows: "when patterns on the reticle R are exposed and formed on wafer W, the focal position of projection optical system PL is always maintained at the predetermined position (i.e. at the resist coated surface) of wafer W, preventing the occurrence of a blurred image and the like and improving exposure accuracy." Takahashi et al. do not disclose imaging optics PL configured to project a blurred image on the substrate. In conclusion, Takahashi et al. teach that a blurred image of a mask (or reticle) on the substrate is undesirable and provide an invention for eliminating blurring of the image.

In preferred embodiments of Applicant's invention the imaging optics is configured to project a blurred image of the spatial light modulator on the substrate. In these embodiments, blurring the image is required to achieve sub-pixel resolution feature edge placement. Applicant's purpose is not to decrease image resolution, but to provide a tool capable of providing low cost, high throughput lithography while achieving high (sub-pixel) resolution. Applicant's method is described by Figs. 10-27 and related discussion in the detailed description.

Appl. No. 10/646,525
Amendment dated June 13, 2006

In summary, Jain et al. discuss blurring due to movement of the patterned image across the substrate and teach that such blurring is undesirable. Jain et al. disclose only projection optics configured to produce a precise image on the substrate. Takahashi et al. discuss blurring due to vibration of components of the lithography tool, teach that such blurring is undesirable, and describe a tool for eliminating the blurring. In contrast, Applicant teaches that blurring is desirable and claims imaging optics configured to blur the image on the substrate.

In view of the above remarks, Applicant respectfully asserts that claim 23 and its dependent claims are allowable over Jain et al. in view of Takahashi et al.

B. Patentability of Dependent Claims 31 and 33

Further consideration will now be given to the patentability of dependent claims 31 and 33. In the discussion relating to the patentability of independent claim 23, it was established that Takahashi et al. do not disclose imaging optics configured to project a blurred image on the substrate. Consequently, it follows that Takahashi et al. also do not disclose: imaging optics configured to project a defocused image on the substrate; and adjustment of the numerical aperture (NA) of the projection lens to blur the image.

In view of the above remarks, Applicant respectfully asserts that claims 31 and 33 are allowable over Jain et al. in view of Takahashi et al.

Appl. No. 10/646,525
Amendment dated June 13, 2006

C. Patentability of Dependent Claim 32

Further consideration will now be given to the patentability of dependent claim 32. Considering the discussion relating to the patentability of independent claim 23, the use of a diffuser is not obvious to one having ordinary skill in the art since Takahashi et al. do not disclose imaging optics configured to project a blurred image on the substrate.

In view of the above remarks, Applicant respectfully asserts that claim 32 is allowable over Jain et al. in view of Takahashi et al.

D. Patentability of Dependent Claim 34

Further consideration will now be given to the patentability of dependent claim 34. In the determination of patentability of claim 34, the Office Action alleges that Takahashi paragraphs 59, 72 and 85 describe a microlens array. Paragraph 59 describes optics used to illuminate the reticle, and does not discuss the projection optics. Paragraph 72 describes the optical components of the projection optical system; however, a microlens array is not described. (A microlens array is a transmissive lens which is composed of many small lenses arranged in an array, for example a fly's eye lens.) Paragraph 85 describes optical components of a position sensing system (position of the projection optics relative to the wafer stage); these optical components are not part of the projection optics which forms an image of the reticle on the wafer. Consequently, Takahashi et al. do not disclose projection optics including a microlens array. Furthermore, in the discussion relating to the patentability of independent claim

Appl. No. 10/646,525
Amendment dated June 13, 2006

23, it was established that Takahashi et al. do not disclose imaging optics configured to project a blurred image on the substrate. Consequently, it follows that Takahashi et al. also do not disclose a microlens array configured to blur the image projected on the substrate.

In view of the above remarks, Applicant respectfully asserts that claim 34 is allowable over Jain et al. in view of Takahashi et al.

E. Patentability of Dependent Claims 38 and 39

Further consideration will now be given to the patentability of dependent claims 38 and 39. In the determination of patentability of claims 38 and 39, the Office Action cites Takahashi et al. paragraph 52 which describes the configuration of the tool shown in Fig. 1 as "a stage apparatus 4 including a reticle stage (mask stage) 2 which moves while holding reticle R and a reticle base plate 3 which supports the reticle stage 2, a projection optical system PL which projects illumination transmitted through the reticle R onto the wafer (substrate) W, a stage apparatus 7 containing a wafer stage (substrate stage, stage body) 5 which moves while holding the wafer and a wafer base plate (base plate) 6 which holds the wafer stage 5, and a reaction frame 8 which supports the stage apparatus 4 and the projection optical system PL." To decipher this sentence from Takahashi et al., it is helpful to refer to both Figs. 1 and 2. There are two stages: the reticle stage 2 carries the reticle R and the wafer stage 7 carries the wafer W. Both of these stages are mounted on the reaction frame 8 using anti-vibration mounts. Between these two stages there is the projection

Appl. No. 10/646,525
Amendment dated June 13, 2006

optics PL, which is mounted on the reaction frame, again using anti-vibration mounts. The projection optics is not mounted on either of the stages. Furthermore, in the discussion of the patentability of claim 23 it was determined that the lithography tool in Takahashi et al. uses a mask or reticle to define the pattern projected onto the substrate (R in Fig. 1) - a spatial light modulator is not disclosed. Consequently, Takahashi et al. do not describe a lithography tool in which a spatial light modulator and/or the imaging optics is carried on a stage.

In view of the above remarks, Applicant respectfully asserts that claim 38 and its dependent claim are allowable over Jain et al. in view of Takahashi et al.

F. Patentability of Amended Independent Claim 43

As discussed above, claim 43 has been amended to unambiguously describe the spatial light modulator as "a plurality of spatial light modulators." The discussion relating to the patentability of independent claim 23 applies here.

In view of the amendments and above remarks, Applicant respectfully asserts that claim 43 and its dependent claim are allowable over Jain et al. in view of Takahashi et al.

G. Patentability of Amended Independent Claim 63

In the Office Action, independent claim 63 was allowed. As discussed above, Applicant has amended this claim to unambiguously claim a tool including a single spatial light modulator. The discussion relating to the patentability of independent claim 23 applies here.

Appl. No. 10/646,525
Amendment dated June 13, 2006

In view of the above remarks, Applicant respectfully asserts that independent claim 63 and its dependent claims are allowable.

H. Patentability of Amended Independent Claim 67

In the Office Action, independent claim 67 was allowed. As discussed above, Applicant has amended this claim to unambiguously claim a tool including a single spatial light modulator. This has no effect on the reasons given for allowance in the Office Action.

In view of the above remarks, Applicant respectfully asserts that independent claim 67 is allowable.

I. Patentability of Amended Independent Claim 68

In the Office Action, independent claim 68 was allowed. As discussed above, Applicant has amended this claim to unambiguously claim a tool including a plurality of spatial light modulators. Claim 68 was further amended to require imaging optics configured to project blurred images of each one of the plurality of spatial light modulators. The discussion relating to the patentability of independent claim 23 applies here.

In view of the above remarks, Applicant respectfully asserts that independent claim 68 is allowable over Jain et al. in view of Takahashi et al.

Appl. No. 10/646,525
Amendment dated June 13, 2006

J. Patentability of Independent Claim 82

The discussion relating to the patentability of independent claim 23 applies here. Consequently, Applicant's lithographic tool described in claim 82 and its dependent claims are patentably distinguishable from the lithographic tool of Jain et al. in view of Takahashi et al.

K. Patentability of Dependent Claim 83

Further consideration will now be given to the patentability of dependent claim 83. At this point it is important to describe some of the characteristics of a spatial light modulator. Jain et al. describe in detail the deformable micromirror device (DMD), which is a spatial light modulator that works in a reflective mode. (Col. 4, lines 26-47 and col. 10, lines 20-50.) An important characteristic of the DMD is that the "device consists of an array of hinged micromirrors which fit on a chip." (Emphasis added.) Fig. 4 in Jain et al. shows just one element of a DMD array. All spatial light modulators are devices consisting of an array of elements or cells, where each element or cell can be individually operated to control either the transmission or reflection of light.

In the determination of patentability of claim 83, the Office Action cites Eggers et al. col. 1, lines 9-21 and 24-35, which discloses "a light modulator that has a plurality of rows of light-modulating cells." This is describing a single spatial light modulator, which is comprised of an array of cells, and not a plurality of spatial light modulators. Eggers et al. only discuss a single spatial light

Appl. No. 10/646,525
Amendment dated June 13, 2006

modulator and their figures show some of the cells of a single spatial light modulator (each cell being represented as a single mirror).

Applicant claims a particular arrangement of a plurality of spatial light modulators. An example of such an arrangement is shown in Applicant's Figs. 5, 6 and 29; note that these figures show spatial light modulators (520-524 in Figs. 5 and 6, and 2910 in Fig. 29) and not the elements or cells that comprise the spatial light modulators.

In view of the above remarks, Applicant respectfully asserts that claim 83, and its dependent claim, are allowable over Jain et al. in view of Takahashi et al. and Eggers et al.

L. Patentability of Dependent Claim 84

Further consideration will now be given to the patentability of dependent claim 84. In the discussion relating to the patentability of claim 83, it was established that Eggers et al. only disclose a single spatial light modulator. Consequently, it follows that Eggers et al. also do not disclose the arrangement of a plurality of spatial light modulators.

In view of the above remarks, Applicant respectfully asserts that claim 84 is allowable over Jain et al. in view of Takahashi et al. and Eggers et al.

Appl. No. 10/646,525
Amendment dated June 13, 2006

M. Patentability of Dependent Claims 86-88 and 90-92

Further consideration will now be given to the patentability of dependent claims 86-88 and 90-92. The discussion relating to the patentability of claims 83 and 84 applies here. Consequently, Applicant's lithographic tool described in claims 86, 88, 90, 91 and their dependent claims are patentably distinguishable from the lithographic tool of Jain et al. in view of Takahashi et al. and Eggers et al.

N. Patentability of Dependent Claim 93

Further consideration will now be given to the patentability of dependent claim 93. The Office Action states that it is mere duplication of an essential working part of a device to have a lens array configured to maximize light intensity on each spatial light modulator in said plurality of spatial light modulators. This is not the case. The lens array is a single device which modifies the illumination "beam shape and angle to match the requirements of the individual SLM[s]." See Fig. 5 and paragraph 52 of Applicant's published application, US 2004/0075882 A1.

In view of the above remarks, Applicant respectfully asserts that claim 93 is allowable over Jain et al. in view of Takahashi et al.

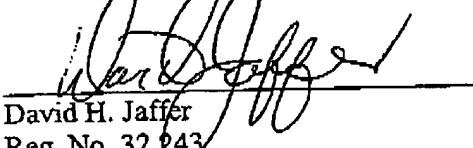
Appl. No. 10/646,525
Amendment dated June 13, 2006

CONCLUSION

Applicant respectfully requests that a Notice of Allowance be issued for this application.

Date: June 13, 2006

Respectfully submitted



David H. Jaffer
Reg. No. 32,243
Customer No. 27498

PILLSBURY WINTHROP SHAW PITTMAN LLP
Intellectual Property Group
P. O. Box 10500
McLean, VA 22102
Tel. No. (650) 233-4510
Fax No. (703) 770-7901